



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

March 18, 2016

Reply To
Attn Of: OEA-095

MEMORANDUM

Subject: Pend Oreille River Model Simulations of Interim Limits on Point Sources

From: Ben Cope, Environmental Engineer
Office of Environmental Assessment

To: Brian Nickel, Environmental Engineer
Office of Water

This technical memorandum follows on a memo dated October 15, 2015, and provides a comparison of water quality conditions when the City of Sandpoint discharges at levels equal to the interim and final permit limitations. We have employed the same CE-QUAL-W2 model for this analysis as was used for the October 2015 memorandum. Please refer to that memo for background information and citations for the model.

Modeling Scenarios

All model inputs were identical to the existing (2009) condition as described in the *Pend Oreille River Phosphorus Load Allocation Analysis: Scenarios Report* (Cadmus et al. 2011), except for discharges from the Sandpoint, Priest River and Dover wastewater treatment plants. For Sandpoint, these were set at the interim and final limit values, as described below.

Scenario 2.1: Final Permit Conditions

City of Sandpoint WWTP

- Effluent flow: 5.0 mgd (constant)
 - Basis: Design flow as stated in most recent permit application

- BOD₅: 30 mg/L (constant)
 - Basis: Proposed permit limit (technology-based)
- TP:
 - June 1 – September 30: 1.46 mg/L
 - October 1 – May 31: 2.30 mg/L
 - Basis: Proposed permit limits

Scenario 3: Interim Limits

City of Sandpoint WWTP

- Effluent flow: 5.0 mgd (constant)
 - Basis: Design flow as stated in most recent permit application
- BOD₅: 30 mg/L (constant)
 - Basis: Proposed permit limit (technology-based)
- TP: 2.30 mg/L (year-round)
 - Basis: Proposed **interim** permit limits
- NH₃: 32.8 mg/L (year-round)
 - Basis: Proposed **interim** permit limits

Results

Scenarios were compared using time series and longitudinal profiles of pH, dissolved oxygen (DO), total phosphorus (TP), ammonia nitrogen (NH₃-N), algae (chlorophyll a) and periphyton (dry-weight biomass). Depth averaged concentrations over the full water column were compared for pH, DO, TP and NH₃-N. Chlorophyll a concentrations corresponded to the predicted values at a depth of 1 meter. For periphyton, the average concentration in the upper 10 meters was used. Below a depth of 10 meters periphyton productivity dropped off considerably. Time series were compared at the outflow of Albeni Falls dam, 10 km downstream of the model's upstream boundary, and 35 km downstream of upstream boundary. Longitudinal profiles were compared for July 3rd at 4 pm (Julian Day 184.625). This date was chosen because it was a warm, summer day with relatively high productivity.

Table 1. Locations and model segments of time series output.

Location	River Mile	Model Segment
10 km downstream of upstream boundary	112.6	42
35 km downstream of upstream boundary	97.5	148
Outflow from Albeni Falls Dam	90.18	198

Average predicted concentrations of the time series output are listed in Table 2 through Table 7, including average concentrations for the entire year and July-September period.

Table 2. Average model predicted concentrations 10 km downstream of upstream boundary for the entire year.

	D. O. mg/l	PO4-P mg/l	NH4-N mg/l	TP mg/l	pH	Periphyton Biomass gD/m ²	Phytoplankton Chlorophyll a mg/l
Scenario 3	9.84	0.0011	0.0164	0.0086	8.47	2.2	1.8
Scenario 2.1	9.81	0.0011	0.0121	0.0085	8.46	2.0	1.7

Table 3. Average model predicted concentrations 10 km downstream of upstream boundary for the July-September period.

	D. O. mg/l	PO4-P mg/l	NH4-N mg/l	TP mg/l	pH	Periphyton Biomass gD/m ²	Phytoplankton Chlorophyll a mg/l
Scenario 3	9.11	0.0009	0.0145	0.0066	8.42	3.7	1.7
Scenario 2.1	9.01	0.0008	0.0141	0.0063	8.38	3.2	1.6

Table 4. Average model predicted concentrations 35 km downstream of upstream boundary for the entire year.

	D. O. mg/l	PO4-P mg/l	NH4-N mg/l	TP mg/l	pH	Periphyton Biomass gD/m ²	Phytoplankton Chlorophyll a mg/l
Scenario 3	9.91	0.0010	0.0141	0.0084	8.45	1.2	1.6
Scenario 2.1	9.87	0.0010	0.0109	0.0084	8.44	1.1	1.5

Table 5. Average model predicted concentrations 35 km downstream of upstream boundary for the July-September period.

	D. O. mg/l	PO4-P mg/l	NH4-N mg/l	TP mg/l	pH	Periphyton Biomass gD/m ²	Phytoplankton Chlorophyll a mg/l
Scenario 3	8.58	0.0009	0.0130	0.0067	8.31	2.5	1.3
Scenario 2.1	8.49	0.0009	0.0139	0.0066	8.27	2.2	1.2

Table 6. Average model predicted concentrations at dam outflow for the entire year.

	D. O. mg/l	PO4-P mg/l	NH4-N mg/l	TP mg/l	pH	Periphyton Biomass gD/m ²	Phytoplankton Chlorophyll a mg/l
Scenario 3	10.0	0.0008	0.0128	0.0078	8.48	2.1	1.6
Scenario 2.1	9.96	0.0009	0.0101	0.0078	8.46	1.9	1.6

Table 7. Average model predicted concentrations at dam outflow for the July-September period.

	D. O. mg/l	PO4-P mg/l	NH4-N mg/l	TP mg/l	pH	Periphyton Biomass gD/m ²	Phytoplankton Chlorophyll a mg/l
Scenario 3	8.82	0.0005	0.0114	0.0060	8.42	3.1	1.6
Scenario 2.1	8.74	0.0004	0.0127	0.0058	8.38	2.9	1.5

Time series and a longitudinal plot for each variable and site location are provided in Figures 1-24. The plots are sequenced as follows: phytoplankton chlorophyll a, periphyton biomass, pH, dissolved oxygen, total phosphorus, and ammonia.

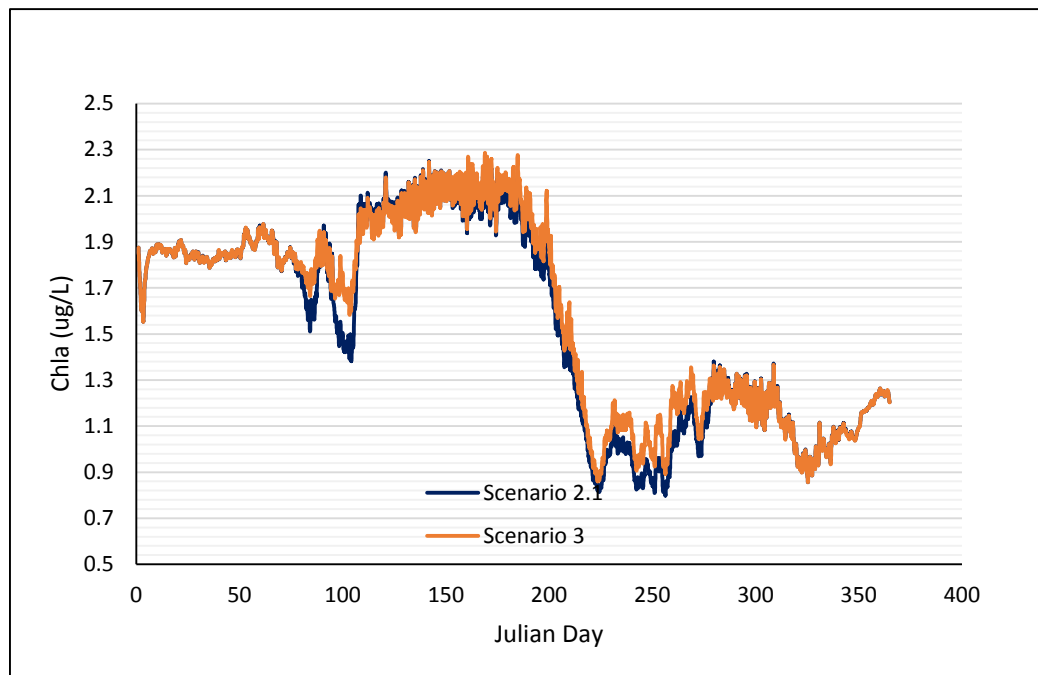


Figure 1. Model predicted phytoplankton chlorophyll a concentrations 10 km downstream of upstream boundary. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

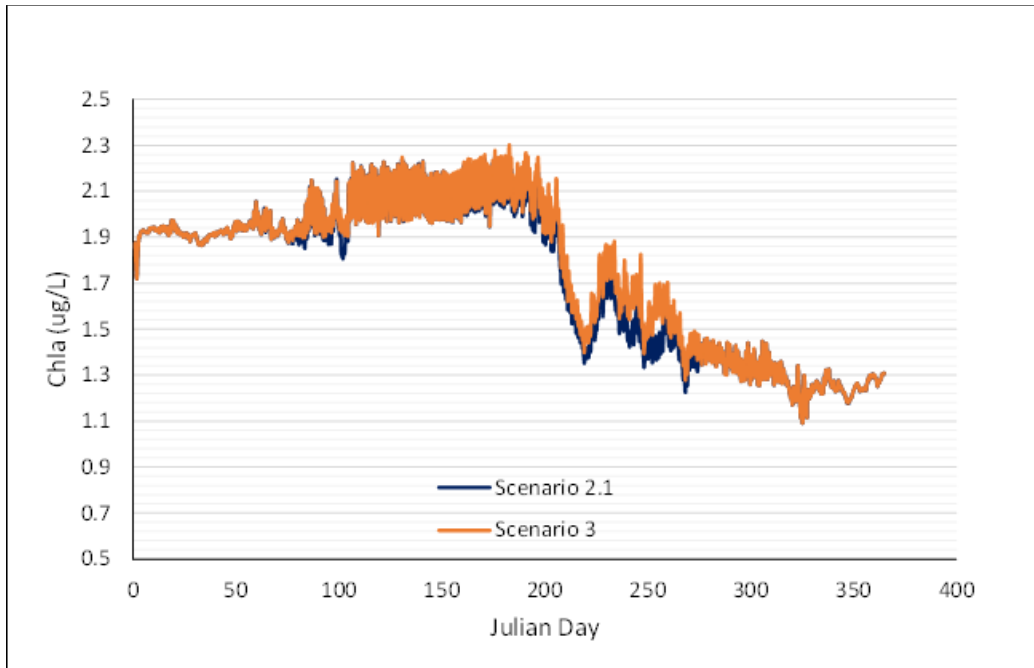


Figure 2. Model predicted phytoplankton chlorophyll a concentrations 35 km downstream of upstream boundary. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

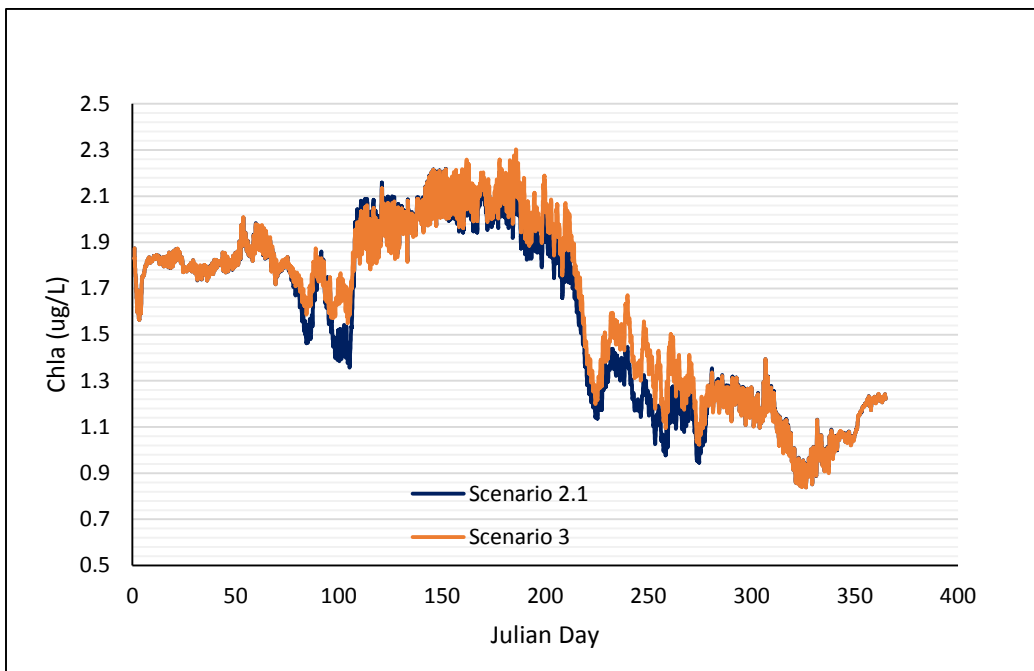


Figure 3. Model predicted phytoplankton chlorophyll a concentrations at Albeni Falls Dam. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

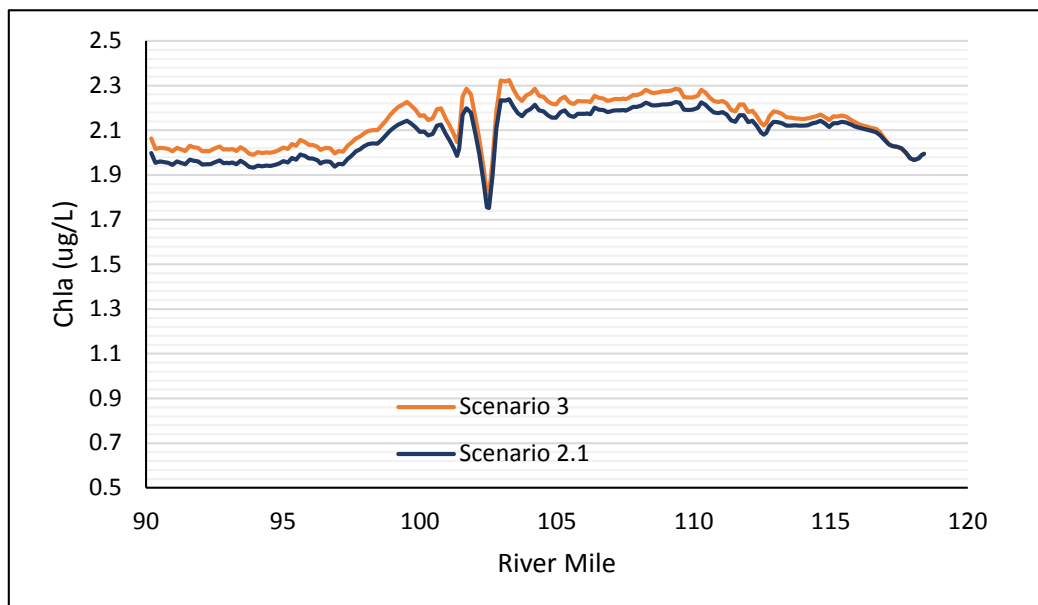


Figure 4. Longitudinal profile of phytoplankton chlorophyll a concentrations on July 3rd at 4 pm (Julian Day 184.625). Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

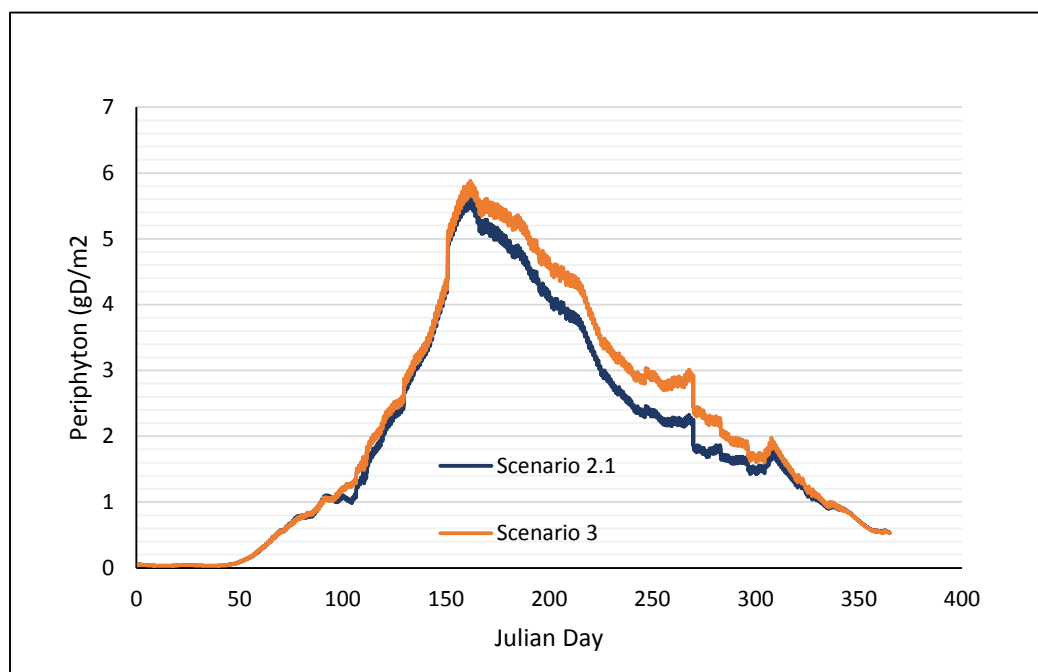


Figure 5. Model predicted periphyton biomass concentrations 10 km downstream of upstream boundary. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

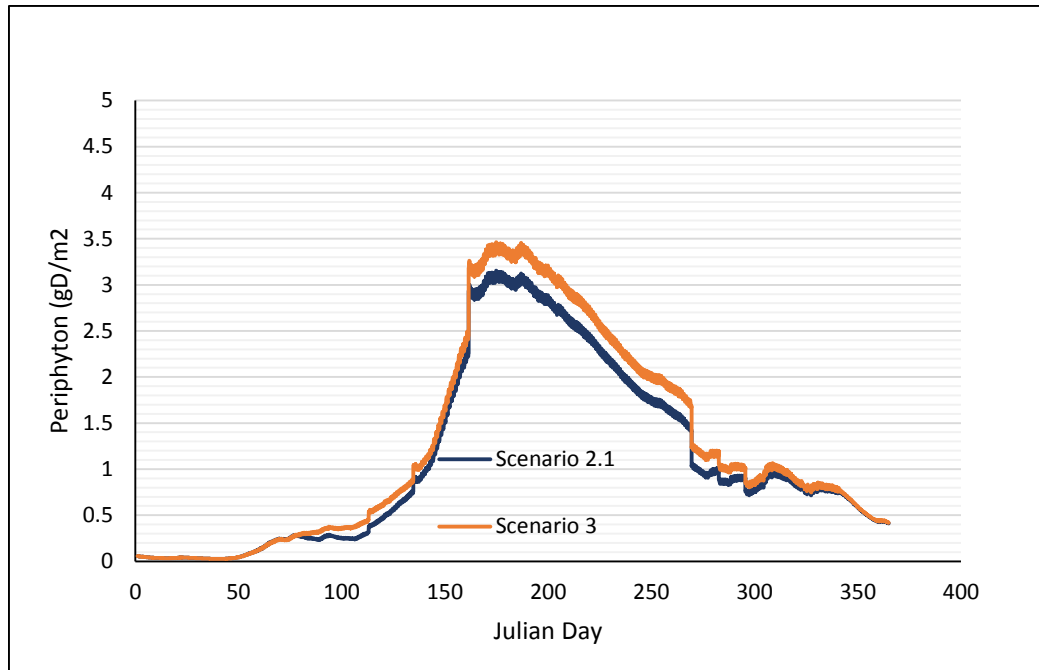


Figure 6. Model predicted periphyton biomass concentrations 35 km downstream of upstream boundary. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

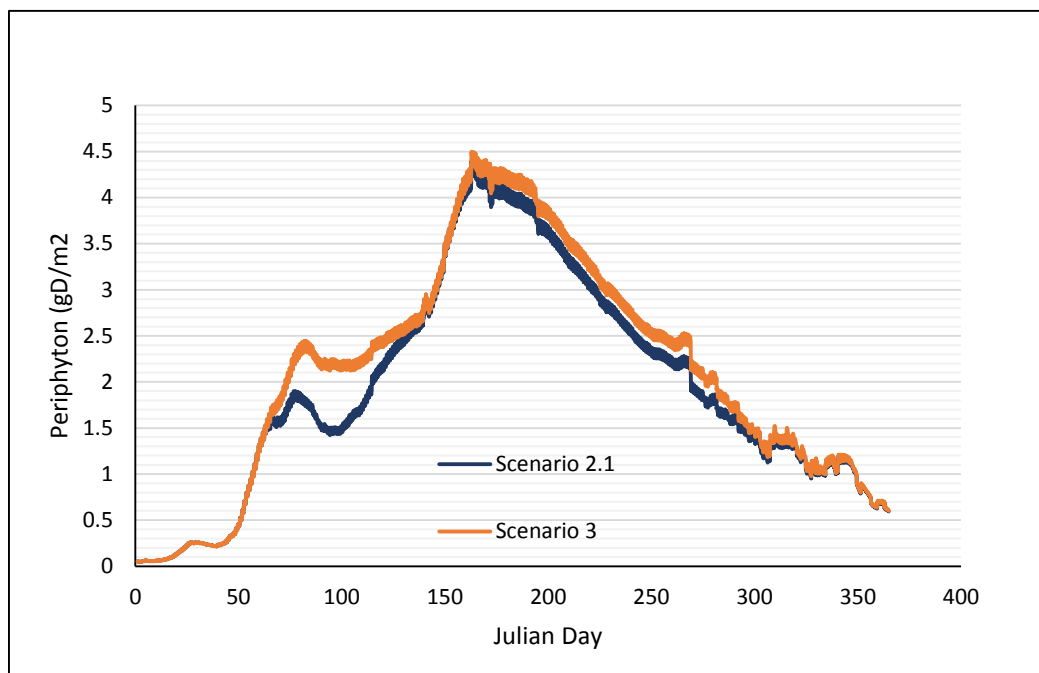


Figure 7. Model predicted periphyton biomass concentrations at Albeni Falls Dam. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

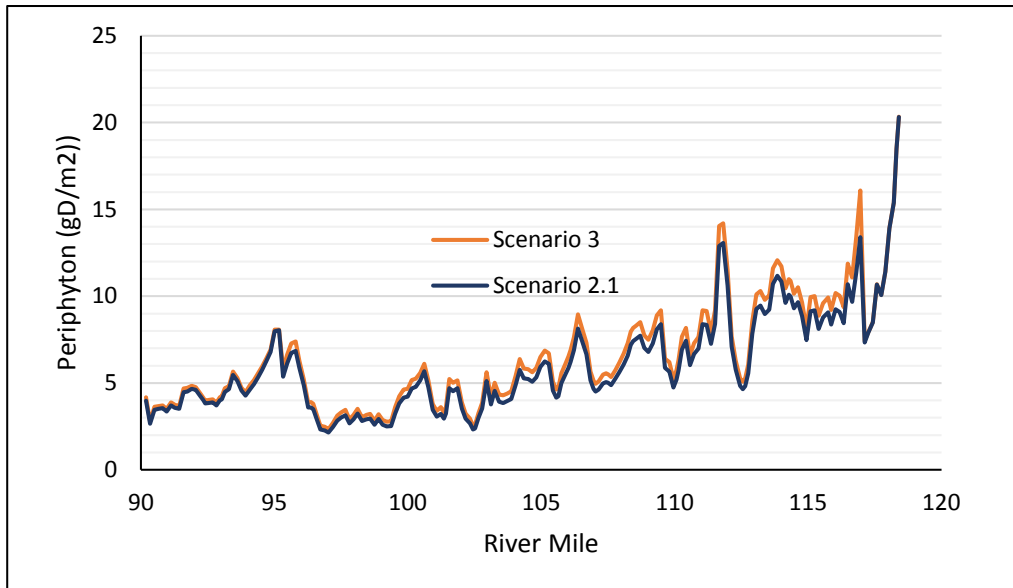


Figure 8. Longitudinal profile of periphyton biomass concentrations on July 3rd at 4 pm (Julian Day 184.625). Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

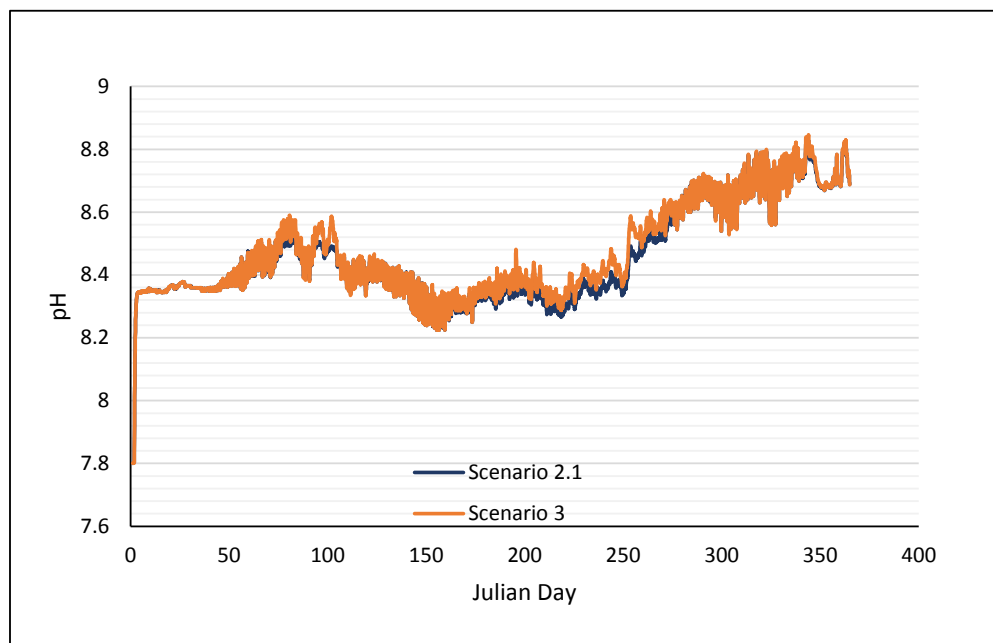


Figure 9. Model predicted pH 10 km downstream of upstream boundary. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

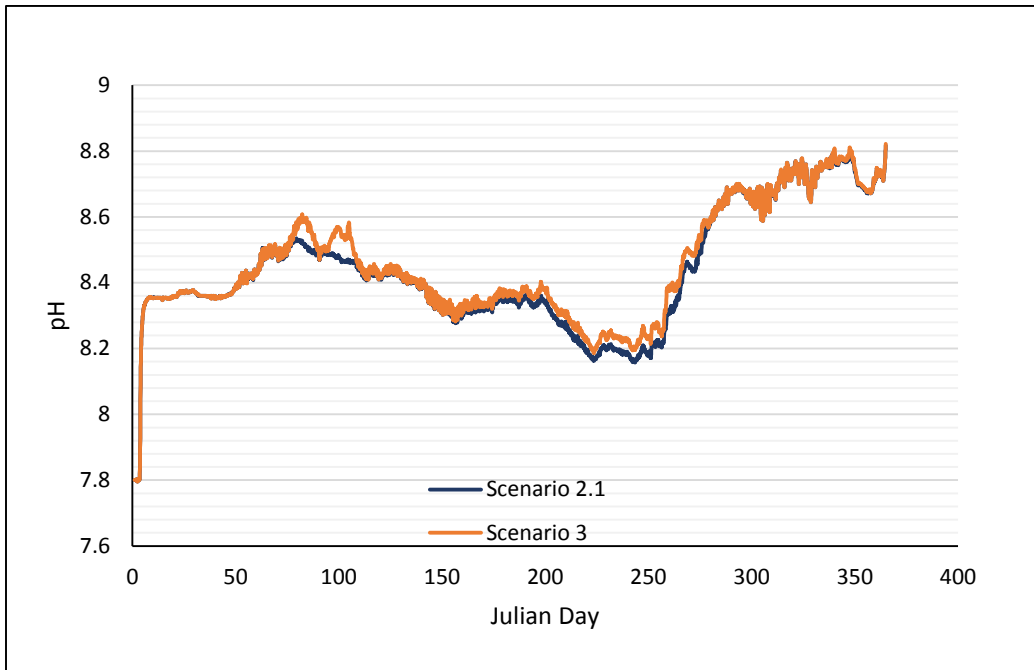


Figure 10. Model predicted pH 35 km downstream of upstream boundary. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

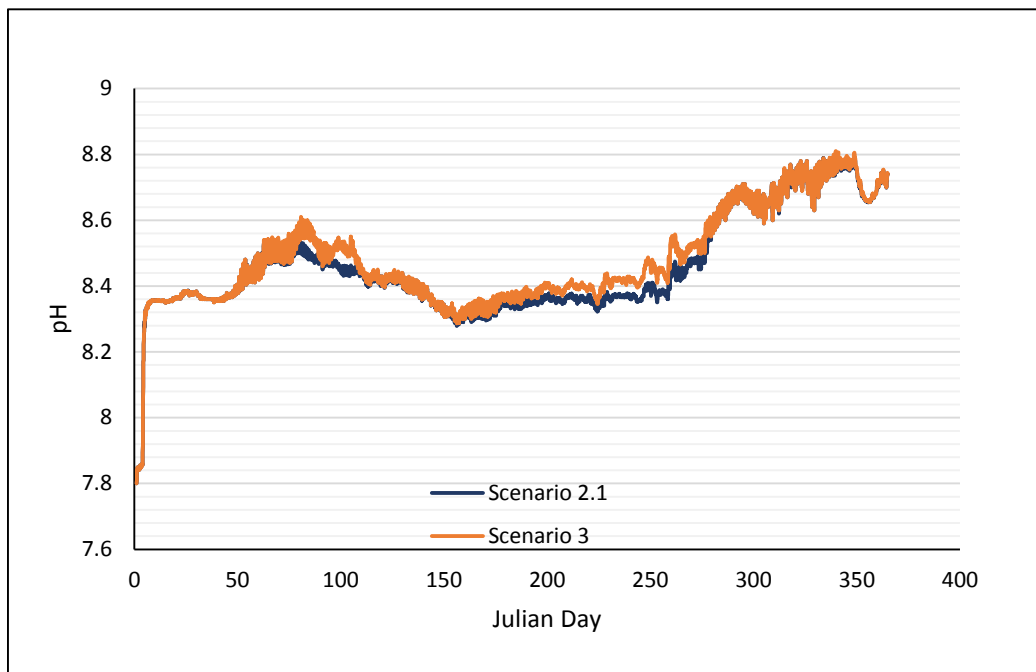


Figure 11. Model predicted pH at Albeni Falls Dam. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

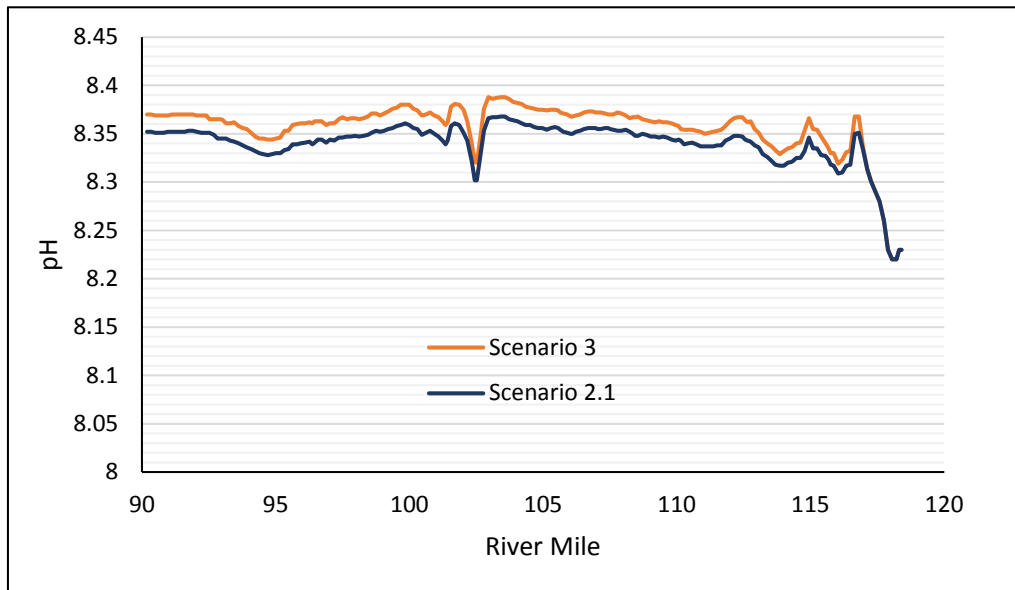


Figure 12. Longitudinal profile of pH on July 3rd at 4 pm (Julian Day 184.625). Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

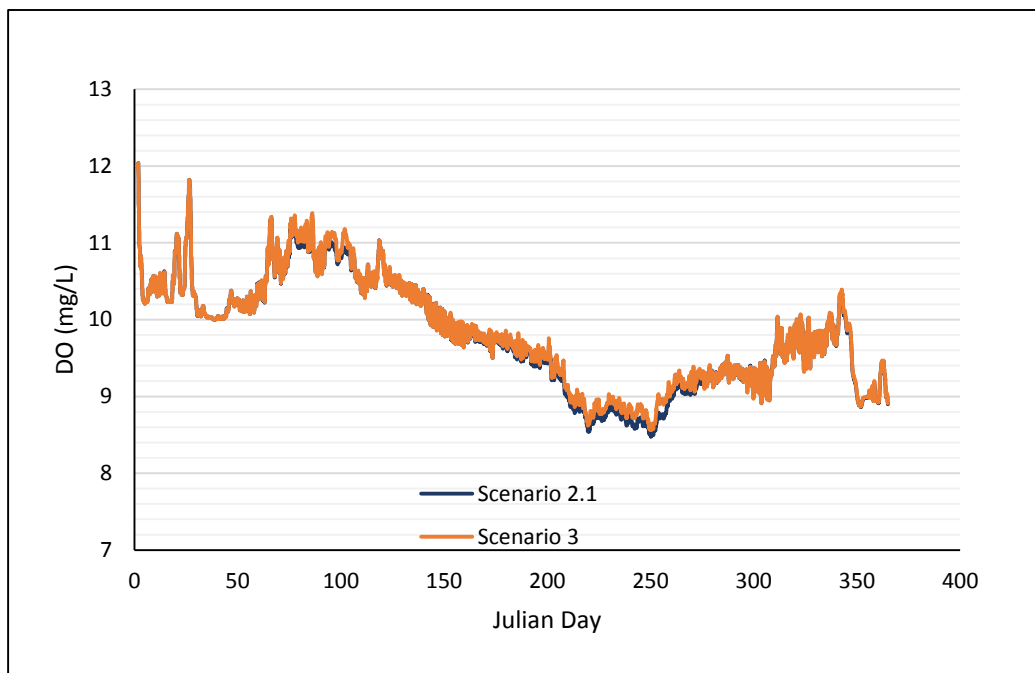


Figure 131. Model predicted dissolved oxygen 10 km downstream of upstream boundary. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

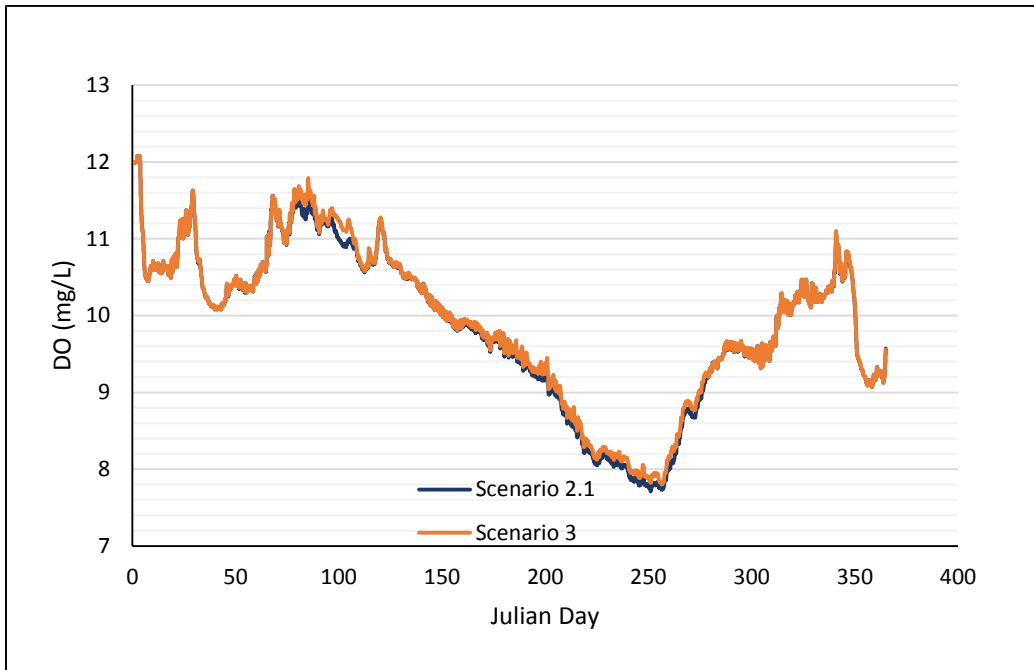


Figure 24. Model predicted dissolved oxygen 35 km downstream of upstream boundary. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

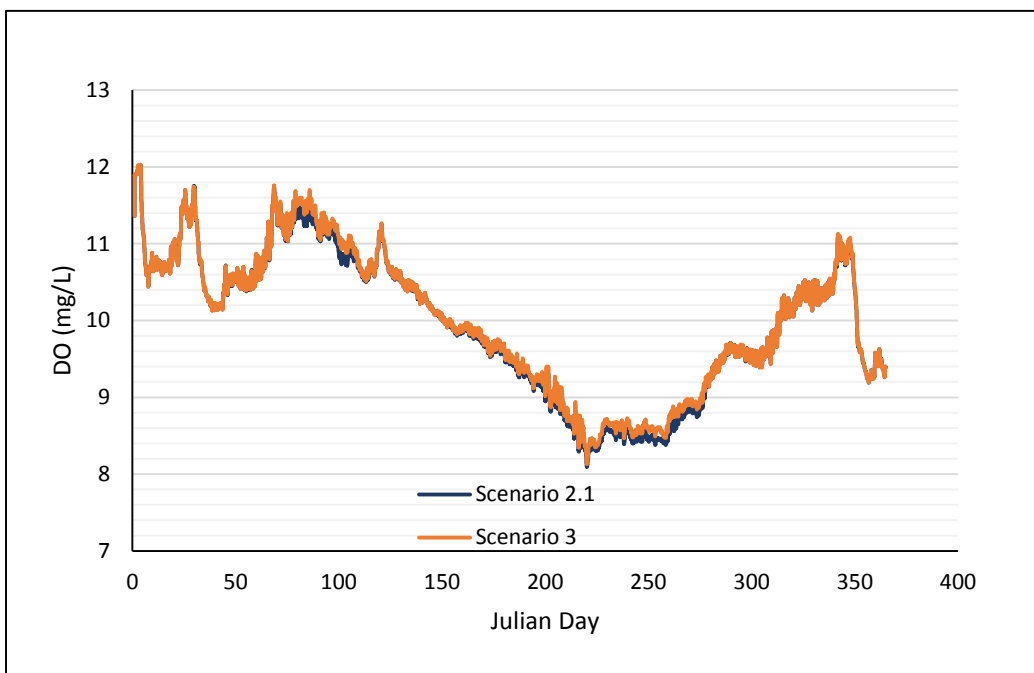


Figure 35. Model predicted dissolved oxygen at Albeni Falls Dam. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

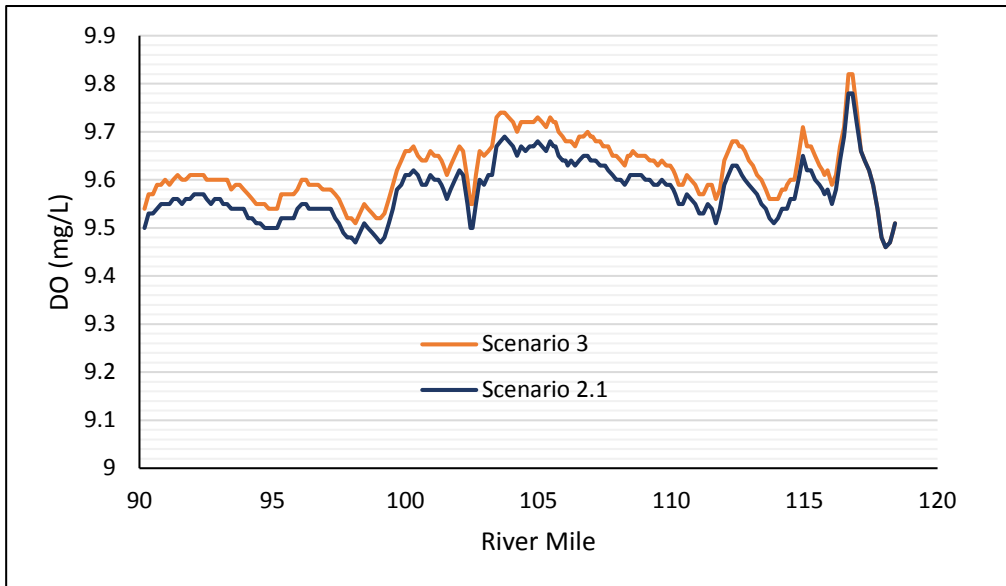


Figure 46. Longitudinal profile of dissolved oxygen on July 3rd at 4 pm (Julian Day 184.625). Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

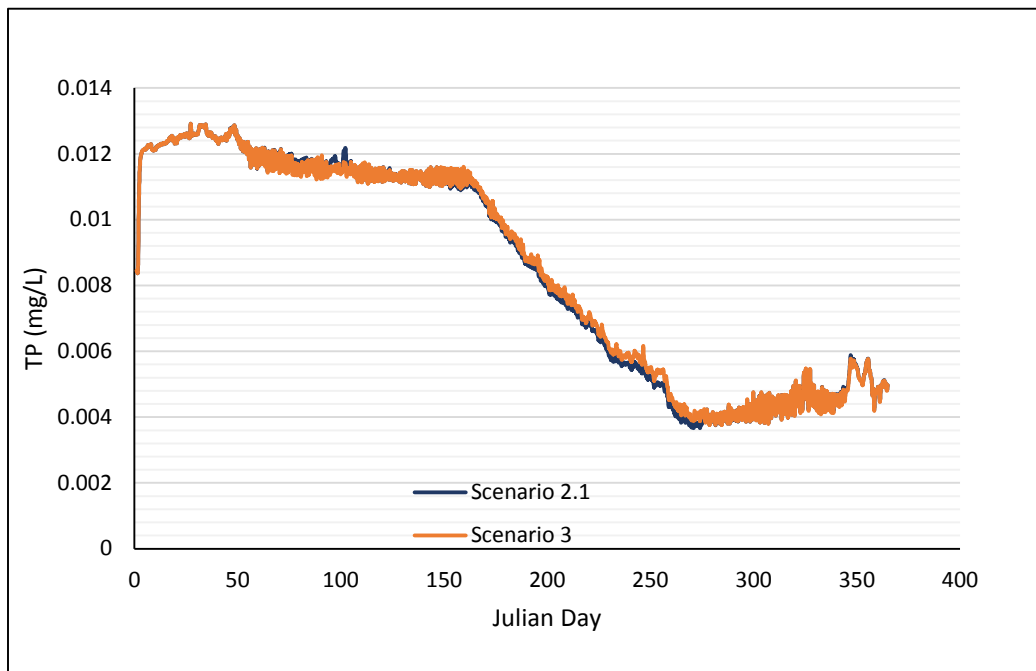


Figure 17. Model predicted total phosphorus concentration 10 km downstream of upstream boundary. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

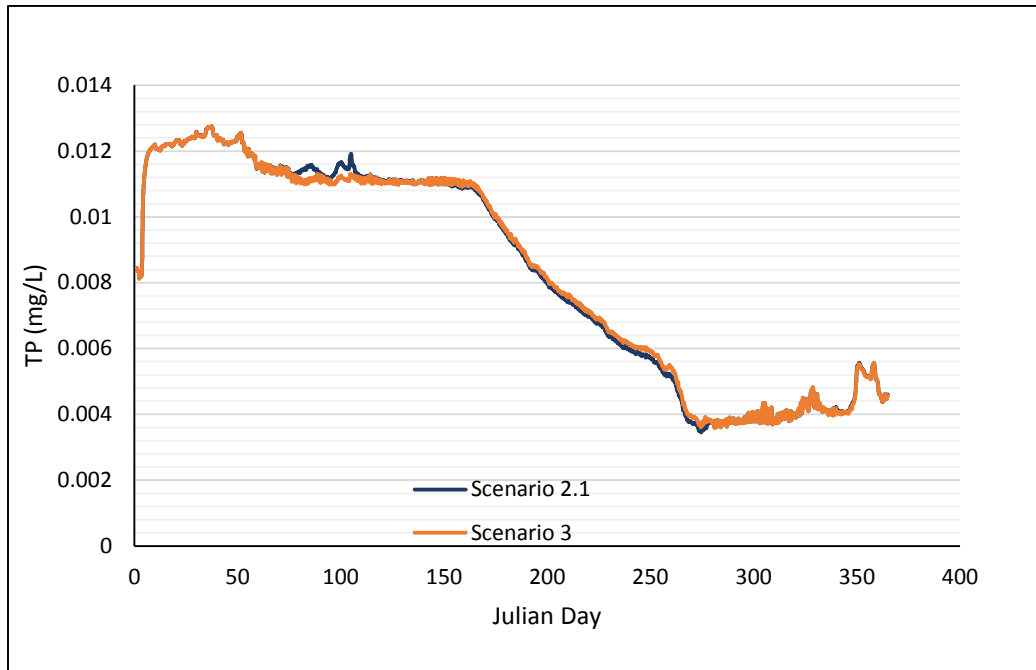


Figure 18. Model predicted total phosphorus concentrations 35 km downstream of upstream boundary. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

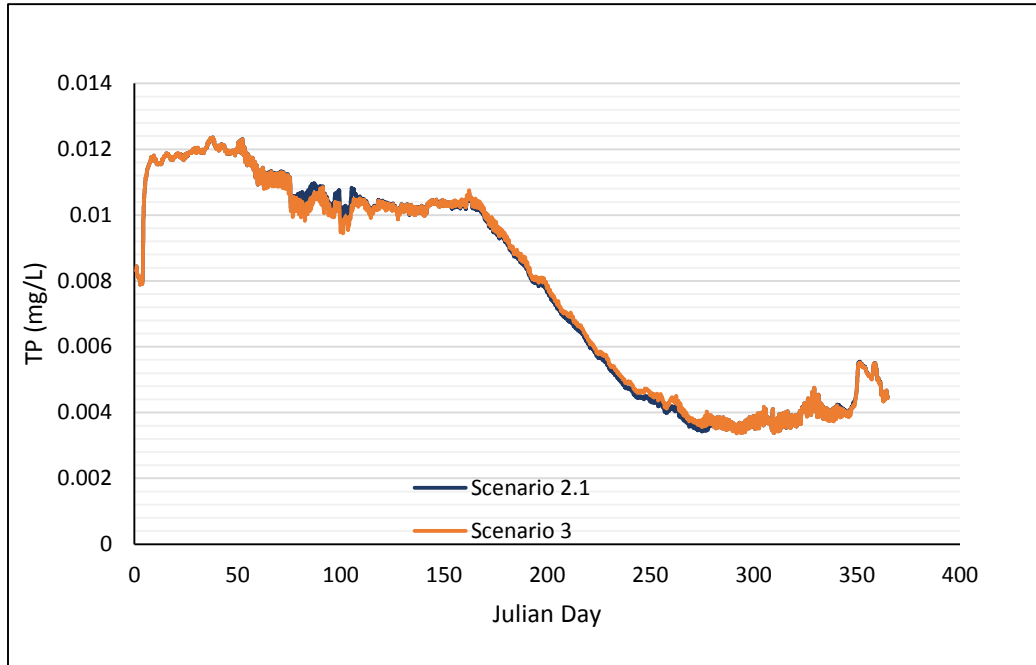


Figure 19. Model predicted total phosphorus concentration at Albeni Falls Dam. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

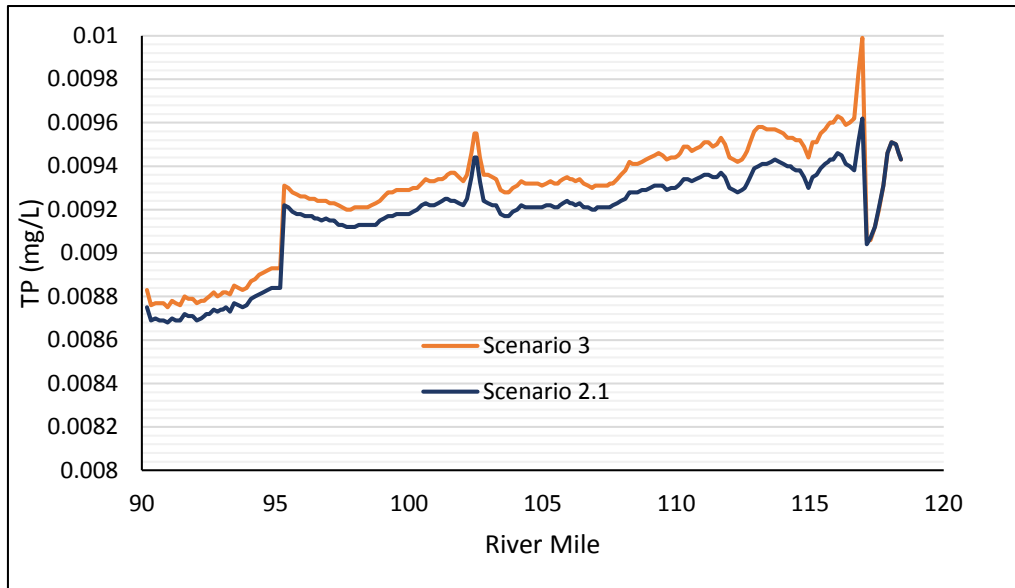


Figure 50. Longitudinal profile of total phosphorus concentration on July 3rd at 4 pm (Julian Day 184.625). Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

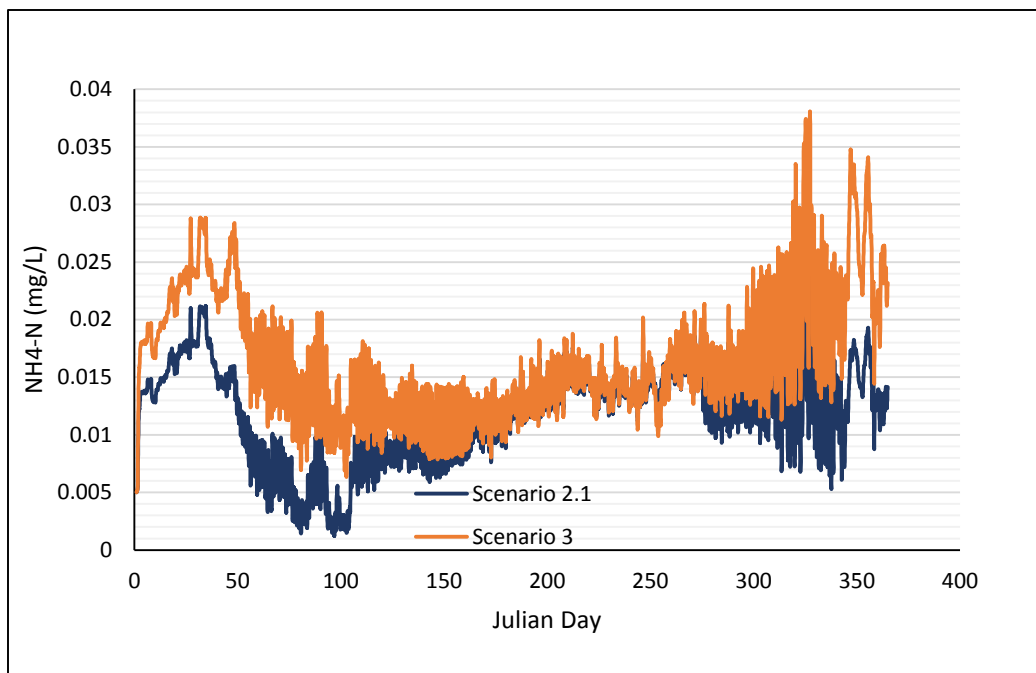


Figure 61. Model predicted ammonia nitrogen concentrations 10 km downstream of upstream boundary. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

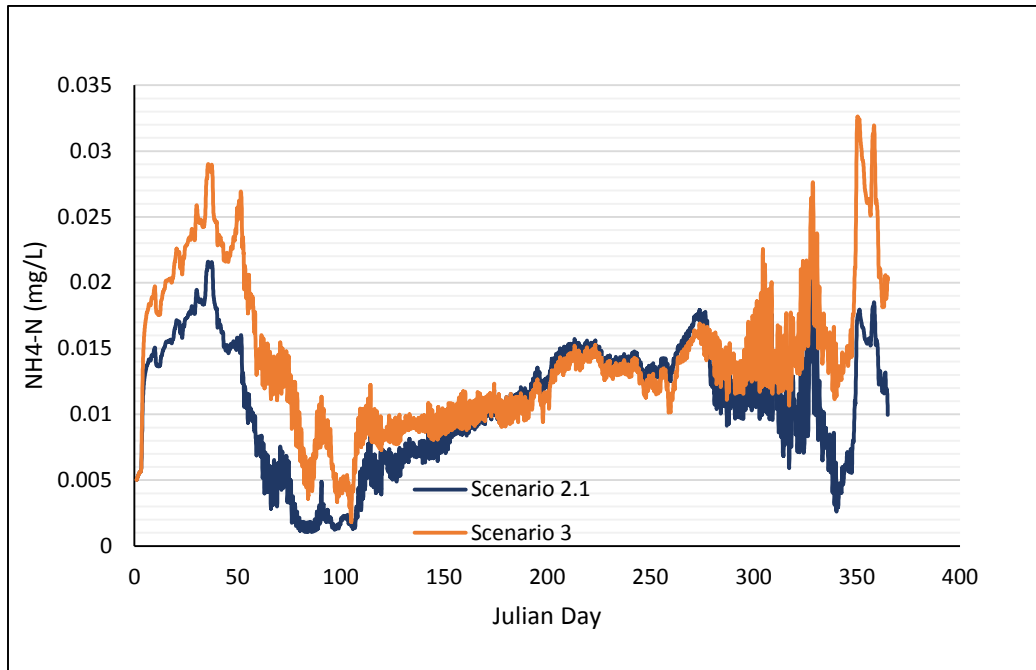


Figure 72. Model predicted ammonia nitrogen concentrations 35 km downstream of upstream boundary. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

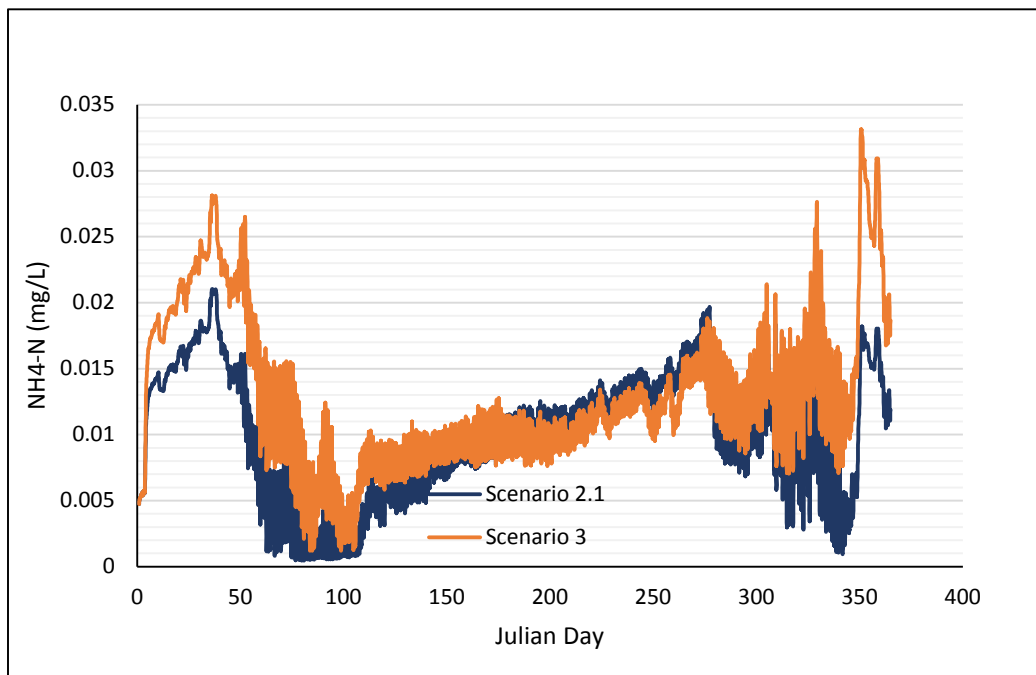


Figure 23. Model predicted ammonia nitrogen concentrations at Albeni Falls Dam. Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

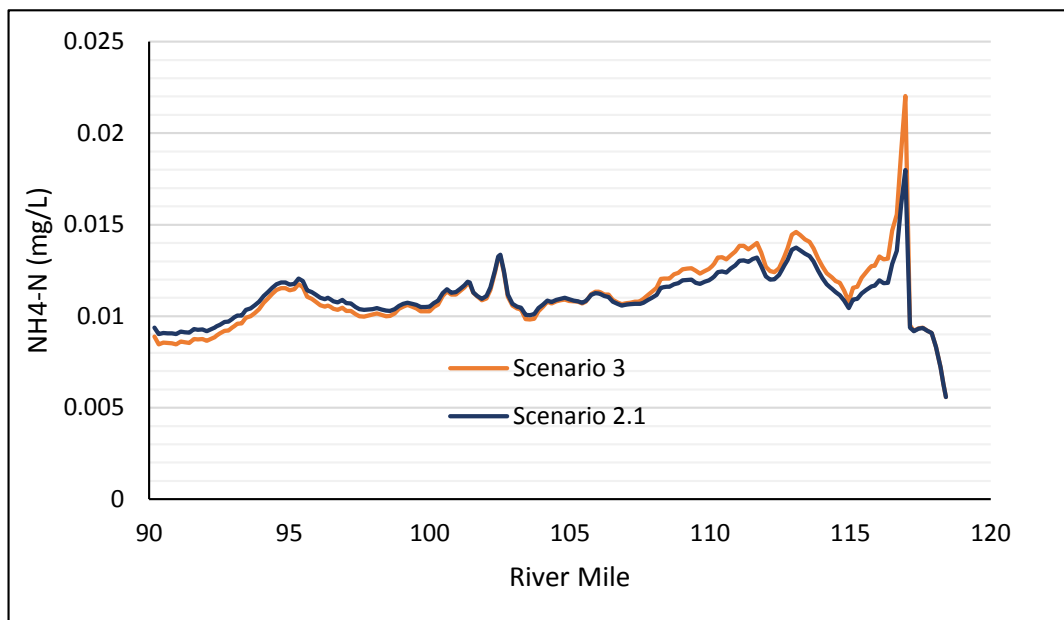


Figure 84. Longitudinal profile of ammonia nitrogen concentrations on July 3rd at 4 pm (Julian Day 184.625). Comparison of Scenarios 3 (Interim Limits) and 2.1 (Final Limits).

References

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